THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

TECHNICAL INFORMATION
REPORT 8-1-1B3(1)

OFFICE, CHIEF OF ORDNANCE
AUGUST 1960

PREPARED FOR THE U. S. ARMY MATERIEL COMMAND BY THE ARMY MATERIEL RESEARCH STAFF, UNIVERSITY OF PITTSBURGH, UNDER CONTRACT DA-36-034-AMC-3785(X).

DEVELOPMENT OF MECHANICAL TIME SUPERQUICK FUZE, T240

The T240 was a dual-purpose 45-second mechanical time superquick (MTSQ) fuze for improved 81-mm and 105-mm high-explosive (HE) mortar shell. Development of the T240 was first considered in February 1951, but it was not until March 1954 that a contract for its development was let and active work on it begun. In 1952 another contract was placed with the same contractor for the development of the T252 MT fuze for 60-mm, 81-mm, and 105-mm illuminating shell; the work on the T252 was given a higher priority than that for the T240. The two fuzes differed in shape but had identical timing, safety and arming, and time-firing mechanisms. They were designed to have the maximum number of interchangeable parts and assemblies. The T252, however, had neither the impact-firing feature nor the booster required for the T240.

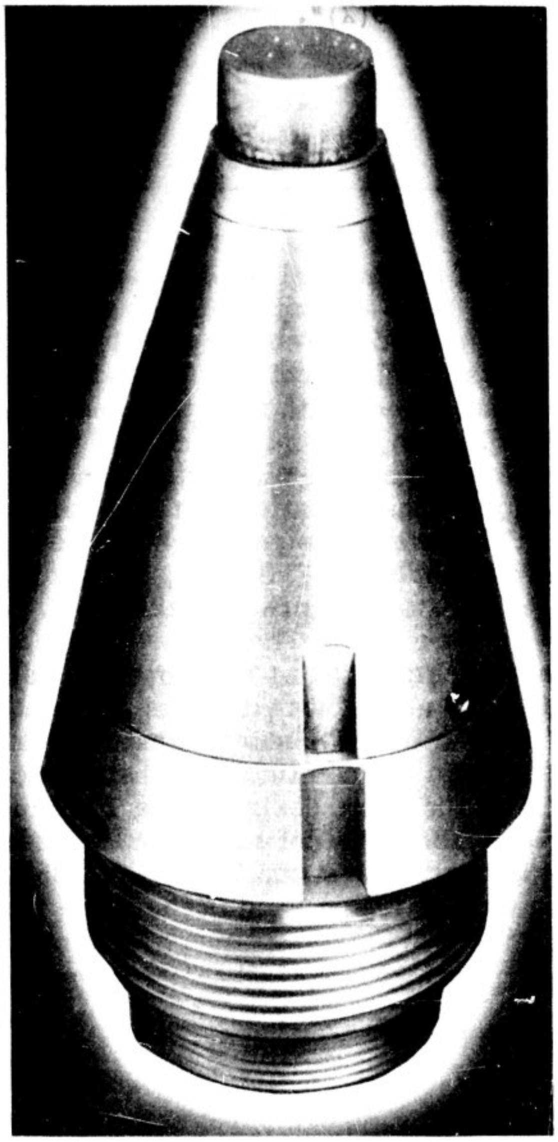
An inert prototype of the T240 fuze was completed in 1954 after models of most components had been fabricated, tested, and modified by the contractor. A second prototype was prepared early in 1955 after tests showed that the fuze passed drop tests of up to 24 feet and that it could be modified to withstand accelerations of up to 18,000 g. By August 1955 the basic design of the T240 fuze was considered sufficiently acceptable for the fabrication of parts for 25 fuzes to be started. In October 1955 comparable engineering-test models of the T252 and T240 fuzes were fired at Jefferson Proving Ground (JPG), and in the same month

RELATED TIR'S

10-59	TIR 6-7-7A1(4)	81-mm HE Shell, T28 Series
3-60	TIR 6-7-7A2(1)	81-mm HE Shell, M362A1 (T376)
1-60	TIR 6-7-7A3	81-mm HE Shell, XM374
	TIR 6-7-7A4	81-mm HE Shell, XM408
8-58	TIR 6-9-7A1(3)	105-mm HE Shell, T53 Series
8-58	TIR 6-9-7A2(1)	105-mm HE Shell, T178 Series
6-57	TIR 6-9-7A7(1)	105-mm HE Shell, T348
3-56	TIR 6-9-7A8	105-mm HE Shell, T353 Series
4-60	TIR 8-1-1(1)	Mechanical Time Fuzes for Artillery and Mortars
8-60	TIR 8-1-1A1(1)	MT Fuze, T252

NOT RELEASABLE TO OFFICE OF TECHNICAL SERVICES.

Frankford Arsenal tested the T252. The latter tests led to minor modifications of the T252 and the T240. A small number of T240's were delivered to Frankford Arsenal in February 1956 for laboratory tests and to JPG for firing tests. In May 1956 the JPG tests indicated that the T240 fuzes functioned satisfactorily at low acceleration, but not at high acceleration.



MTSQ FUZE, T240

Consequently, the setback-release mechanism used in the T240 and in the T252 was redesigned. The T252 with the redesigned release mechanism was then tested, and it performed satisfactorily. Fabrication of a test lot of T240 fuzes with the improved setback-release mechanism was started in June 1956, and 81-mm HE shell with the improved fuze were tested at JPG early in October of that year. Except for some duds that were probably caused by buckling of the firing pins, the tests demonstrated that the fuze was generally satisfactory and that the timing mechanism functioned properly. The making of a larger quantity of T240 fuzes was authorized for final tests that were planned to be run in 1957.

Work by the contractor on the T252 and T240 was suspended before the T240 fuzes that had been authorized were built. In May 1957 development of the T240 was taken over by Frankford Arsenal, but the parts that had been made for it by the contractor did not become available until October 1958. In the interim, the fuze was changed to strengthen it, and its body and cap were redesigned. No parts had been modified by March 1959, however, when Frankford Arsenal received verbal notification of the suspension of work on the T240 fuze. Officially, the development of the fuze was ended in May 1960.

The T240 MTSQ fuze was designed to match in weight and contour the T186 superquick and delay fuze, which initially was intended to weigh a pound. Difficulty was experienced in attaining this weight, not only in the T240 but also in the T186 and the matching T178 proximity fuze. The weight limitation was

therefore raised from 1 to 1.15 pounds, and to meet this weight aluminum was employed in the body, booster, and some parts of the mechanism.

Since the fuze was designed for nonrotated projectiles, it could not be made to function by centrifugal force. The timer had a spring-actuated movement that was released by setback force when the projectile was fired, and the safety and arming mechanism was also actuated by setback forces. A setback force of approximately 250 g was sufficient to start the timer and operate the safety and arming mechanism.

The T240 fuze had the following main components.

1. An aluminum housing (or body) with a setting line, an exterior 2-inch thread for screwing into a projectile, an exterior 1.5-inch thread for receiving a booster, and an interior cavity to receive the timer and the arming-mechanism assembly

2. An aluminum cap containing a hammer-weight-and-spring assembly, a setting pin, and a time scale graduated in 1-second increments from 2 to 45 and numbered every 5 seconds

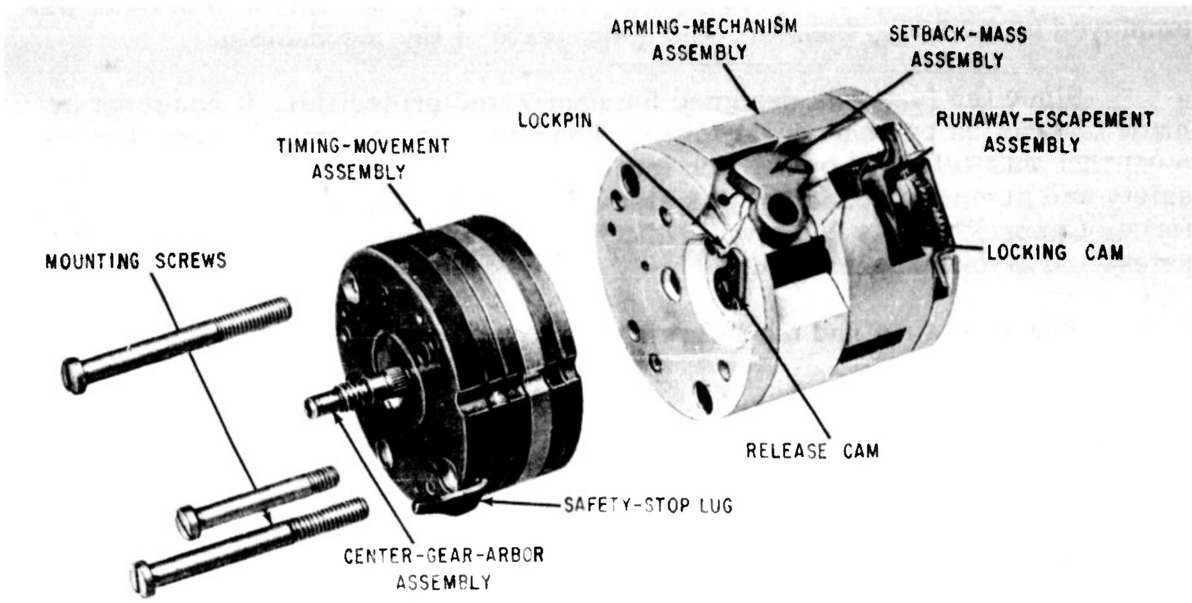
3. A point-detonating mechanism comprising an aluminum cup-shaped striker, an aluminum adapter that screwed into the cap to hold the striker to the fuze, and a firing-pin extension that was in line with the firing pin

4. A timing movement to control the operation of the firing pin for time firing

5. An arming mechanism that had a barrier (rotor) containing an M29 percussion primer and a rounded-tip firing pin that extended into the timing mechanism

6. An aluminum booster cup containing a tetryl booster pellet

A prewound stainless-steel spiral spring drove the clockwork timing movement. This spring was mounted in a barrel assembly with external teeth, by means of which the spring was wound. A timing disk at the upper end of the movement was mounted on a central arbor through a Belleville spring in such a way that it was free to turn, relative to the arbor, by means of the setting pin in the cap; there was no slippage of the disk, however, when it was turned by the movement. A turned-up fork on the timing disk locked the movement of the timing disk to that of the setting pin. The timing disk was freed from the setting pin when the fork was bent down by the hammer of the hammer-weight-and-spring assembly when the cartridge was fired. A safety stop (lug) on the movement prevented the hammer from moving until the fuze had been set. A notch



TIMING-MOVEMENT AND ARMING-MECHANISM ASSEMBLIES OF MTSQ FUZE, T240

on the timing disk received the firing arm at the set time. A safety disk, which was mounted immediately below the timing disk, had a projection that held the firing arm from the timing disk, during shipment of the fuze. Until the fuze was set at the minimum safe time, this projection was in alignment with the firing notch, so that the firing arm could not enter the firing notch until after the fuze had been set and the movement had operated for the set time. The speed and accuracy (to within 1 per cent of the time set) of the timing movement were controlled by an escapement, which was adjusted before the movement was put into the fuze.

Starting of the timing movement was controlled by the arming mechanism, which was directly below the timing movement. The timing movement controlled the firing mechanism in the arming mechanism for time firing. The tubular main arbor of the timing mechanism was on the longitudinal axis of the fuze. It contained the upper end of the firing-pin stem and the lower end of the firing-pin extension that was provided for impact firing.

The fuze was armed by the arming mechanism, which comprised:

1. A setback-mass assembly and lockpin

2. A runaway escapement and shaft

3. An arming barrier, a barrier lock, and a locking cam

4. A firing-pin assembly

This mechanism controlled the arming for both time and impact firing. Arming took place by means of the linear acceleration caused by the firing of the cartridge.

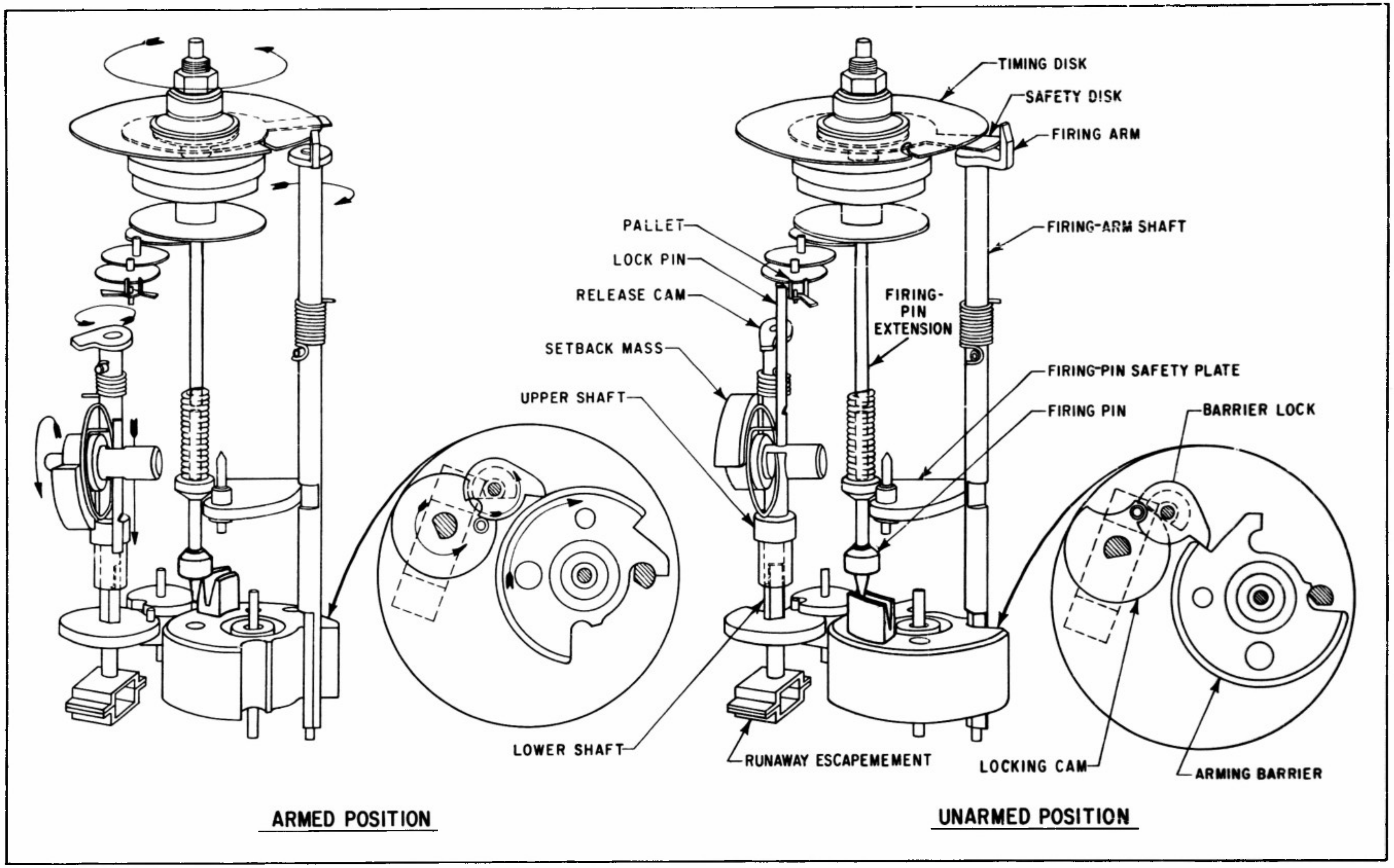
In the unarmed position, the lockpin in the arming mechanism restrained the escapement lever of the timing movement and a release cam on the shaft of the runaway escapement. In this position the lockpin rode on the shaft of the setback mass, which was an unbalanced flywheel. The mass was fixed to the shaft so that setback forces would act to rotate it and the shaft against the restraining action of a torsion spring. The imbalance of the setback mass and the strength of the spring were so adjusted that a force of 250 (plus 50) g acting for 3 to 8 milliseconds was required before the setback mass would rotate through 90 degrees — the amount of rotation needed to free the lockpin and to permit it to move backwards under the setback force. This movement of the lockpin freed the escapement lever of the timing movement and the release cam of the runaway escapement of the arming device. The lockpin also locked the setback weight and prevented it from returning to its former position.

When the release cam was freed from the lockpin, the spring-driven runaway escapement began to turn the locking cam. The runaway escapement was a gear train that slowed the motion of this cam. When the cam had rotated about 300 degrees it permitted the barrier lock to rotate and free the arming barrier from control of the barrier lock.

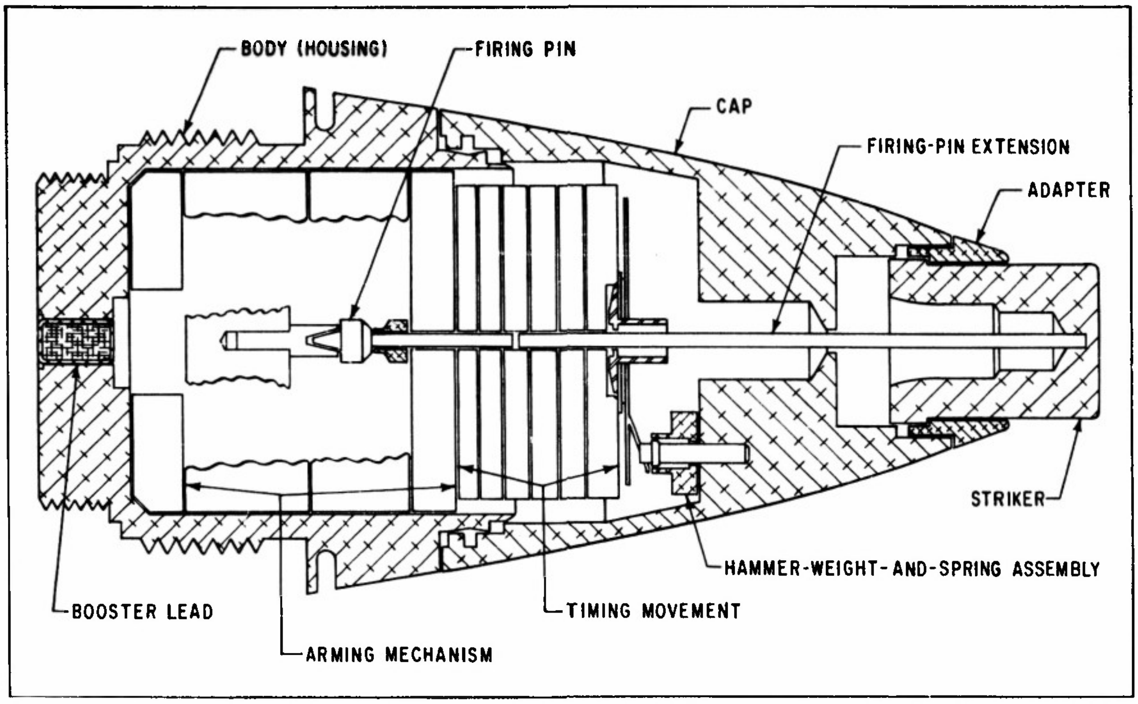
The mainspring of the clockwork, which had been locked in the wound position, began to unwind upon the freeing of the escapement lever. This turned the safety and the timing disks through the gear train. When the lug on the safety disk had traveled beyond the firing arm, the latter turned to rest on the timing disk. This rotation freed the arming barrier from the firing-arm shaft. Because the barrier had also been freed from its lock, it turned under the force of a stressed torsion spring. This armed the fuze for both time firing and impact firing by bringing the M29 primer into line with the firing pin.

Time firing occurred when the firing arm dropped into the firing notch at the set time. The firing-arm shaft then rotated and turned a D notch on the shaft sufficiently to permit the firing-pin-safety plate to rotate, thereby freeing the firing pin. A prestressed compression spring then drove the firing pin against the detonator with a force of 22 inch-ounces.

The timing safety disk precluded the entrance of the firing arm into the firing notch on the timing disk for from 1 to 1.5 seconds after the round was fired. Unless the fuze was set for a longer time, it could not function because the safety stop on the movement prevented the hammer from freeing the timing



SCHEMATIC VIEW OF TIMING-MOVEMENT AND ARMING-MECHANISM
ASSEMBLIES OF MTSQ FUZE, T240



LONGITUDINAL SECTION OF MTSQ FUZE, T240, SHOWING POINT-DETONATING MECHANISM

movement from the hammer-weight pin that stopped the movement by holding the timing disk. Therefore, the arming barrier would not be freed from the firing arm. This acted as a safety measure in the event the fuze or the round containing it was dropped tailfirst for a sufficient distance to turn the setback mass through its full cycle to free the lockpin and free the barrier from its lock. The firing-arm shaft would still hold the barrier in the unarmed position (a) until after the fuze was set and the round was fired, (b) until the hammer released the movement from the hammer pin, and (c) until the firing arm dropped from the safety disk to the timing disk.

If, through some fault in the fuze, the barrier was released from the firing-arm shaft before it was released by the barrier lock, the fuze would be a dud. The force of the torsion spring of the barrier would put pressure on the barrier lock and cause sufficient friction between the barrier lock and the locking cam to prevent rotation of the runaway escapement when it was released from the lockpin.

The barrier contained a V-shaped groove, forming a short arc with the axis of the barrier as its center. In the unarmed position of the barrier, this groove kept the firing pin from moving backwards, and the firing-pin extension

and the cup-shaped striker kept the firing-pin extension from moving forward. As the barrier turned on its axis to the armed position, the V-shaped groove moved under the firing pin, disengaging it when the primer moved under the firing pin.

Only one firing pin and one primer were used in the fuze. In the armed position, the firing pin could be moved against the primer either by the firing spring of the timing movement at the set time or by the rearward movement of the striker if the projectile hit a target before the set time. The detonator, which was fired when hit by the firing pin, set off, in turn, a booster lead in the base of the fuze and a booster pellet in the cup screwed to the base of the fuze.

Either as a separate item or when assembled to a cartridge, the fuze was shipped in the safe position, with the S on the cap aligned with the setting mark on the body. To prepare the fuze for firing, it was only necessary to turn the cap clockwise until the desired time setting was aligned with the setting mark on the body. If the fuze was inadvertently set for a longer time than desired, to ensure accuracy the cap was turned clockwise until the proper setting was reached. No damage was done if the cap was turned more than 360 degrees. If the cartridge was prepared for firing by setting the fuze but was not fired, the cap was rotated clockwise until the S on the cap was aligned with the setting line on the body. The T240 could be set within an accuracy of 0.5 second.

As assembled for shipment, the T240 had the following safety features.

1. The safety stop prevented the hammer weight from releasing the timing disk from the setting pin until after the fuze was set.

2. After the fuze was set, the hammer weight would not bend the setting lug on the timing disk to release it from the setting pin until after the round was fired or dropped tail-first from a height of over 10 feet.

3. Unless the setback mass was subjected to a force of not less than 200 to 300 g for from 3 to 8 milliseconds it would not move far enough to release the lockpin holding the escapement and the firing-pin spring.

4. The arming barrier could not turn to the armed position until released by the runaway escapement and the barrier lock. Until the arming barrier turned to the armed position the firing pin could not move, and the detonator was out of line with the firing pin and the booster lead charge.

PRINCIPAL CHARACTERISTICS

Model	T240
Type	MTSQ
Materials	
Striker	aluminum
Cap	aluminum
Body	aluminum
Timer	brass, aluminum, and stainless steel
Arming mechanism	brass, aluminum, and stainless steel
Booster cup	aluminum
Weight, with booster	1.25 lb
Length, with booster	5.96 in
Length of intrusion	2.21 in
Maximum diameter	2.4 in (approx)
Thread size	2-12NS-1
Time-range setting	
Method	fuze wrench
Maximum	45 sec
Minimum	2 sec
Accuracy	0.5 sec
Direction of setting	clockwise
Arming	
Time of arming delay	0.5 to 1.5 sec (approx)
Acceleration required	250 g
Actuation	
Method	time and impact
Minimum time for functioning	2 sec
Percussion primer	M29
Temperature limits	-40° F and 125° F
Projectiles with which fuze was to be used	M362 81-mm HE shell; T53-series 105-mm HE shell